Responsive Polymer Multilayers

Svetlana Sukhishvili, Stevens Institute of Technology, DMR-0209439

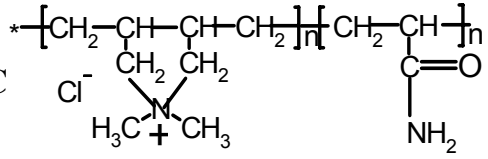
The goal of our research is to understand the principles of building responsive polymer multilayers, specifically the role of hydrogen bonding interactions on stabilization and pH response of self-assembled polymer films.

We first present our study on the competitive role of hydrogen bonding and electrostatic interactions in growth and stability of polymer multilayers. For self-assembly of cationic copolymers with a weak polyacid, we found different regimes of multilayer stability corresponding to variations of external pH, with significant stabilization of multilayers due to hydrogen bond formation [*Macromolecules* 2003, *36*, 9950]. Competition of hydrogen and electrostatic interactions is also demonstrated for hybrid H-bonded/electrostatically self-assembled multilayers [*Langmuir*, in press].

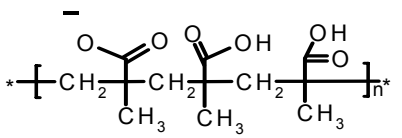
We then show that multilayers stabilized by hydrogen-bonding can be deposited onto a spherical solid template, producing polymeric capsules with rationally designed pH response of the membrane [*Macromolecules* 2003, 36, 8590; to be submitted to *Langmuir*].

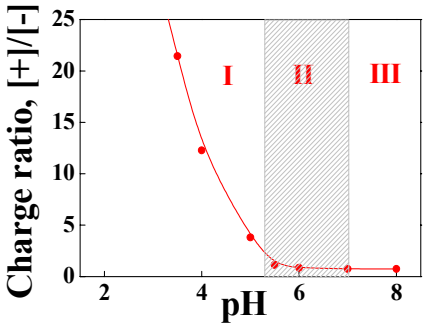
These studies provide a new insight into the relationship between the types of interactions involved in the self-assembly of macromolecules with the static structure and response properties of ultrathin polymer films.

PAAm-DMDAAC



PMAA



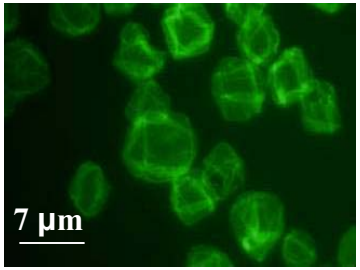


I – hydrogen bonding interactions

II - hydrogen bonding & electrostatic interactions

III – electrostatic interactions

Switching of hydrogen bonding to electrostatic interactions in cationic copolymer/polyacid multilayers.



Hollow pH-responsive polyvinylpyrrolidone/ PMAA capsules stabilized by hydrogen bonds

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Education:

Funding provided by the NSF supported two Ph.D. students: Veronika Kozlovskaya (2nd year), Eugenia Kharlampieva (3rd year), and a visiting scientist Vadimir Izumrudov (Moscow State University, Russia). Knowledge accumulated in the group as a result of the NSF support enabled three undergraduate students, Ms. Lauren Klein, Mr. Jason Tholany and Mr. Vikalp Jane, to participate into summer research program, and one student, Mr. Salim Ok, to complete his M. S. degree. Finally, a high school student Carlos Ortiz, sponsored through the ACS project SEED, was participating in the NSF-supported research in our group.

Outreach:

Undergraduate and graduate students participate in the summer high school student research programs, sponsored by the ACS project SEED project. The picture below shows PI and several participating students in 2004.

NSF-supported project have been used into several presentations for a broad community of New York City and NJ businessmen, and to a present president of the Dominican Republic Leonel Fernandez on February 12, 2004. Results were also presented in four invited talks given at companies and universities.